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How to improve governance of a complex social-ecological problem? : Dioxins in Baltic salmon and herring

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How to improve governance of a complex social-ecological problem? Dioxins in Baltic salmon and herring

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ABSTRACT

This article focuses on the dioxin problem of Baltic herring and salmon fisheries and its governance that is based on natural scientific knowledge. The dioxin problem weakens the perceived quality of Baltic salmon and herring as food and affects the way the catches can be used. This influences negatively the fishing livelihood, the coastal culture, and the availability of the fish for consumers. We explored how the governance of the dioxin problem could be improved, to better address its socio-economic and cultural implications. We identified four main actions: (1) adopt environmental, economic and social sustainability, and food security and safety as shared principles between the environmental, food safety/public health, and fisheries policies, (2) establish collaboration between the environmental, public health, and fisheries sectors at the regional level, (3) enhance interaction around the dioxin problem within the fisheries sector, and (4) support the participation of the Baltic fisheries stakeholders in the EU-level food safety governance. Viewing dioxins in fish not only as a natural scientific problem but as a multidimensional one would enable a wider toolbox of governing instruments to be developed to better address the different dimensions. This would support steps towards collaborative governance and a food system approach.

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1. Introduction

Governing problems that cross boundaries between the environment, society, and human health and that involve not only factual but also socio-cultural dimensions, is challenging (Gilek, Karlsson, Linke, & Smolarz, 2016). The multidimensional character of such problems requires multidimensional governance, yet a narrow 'silo-perspective' is still dominant, often revealing or creating other problems (Jennings et al., 2016). This applies to the governance of the dioxin problem of Baltic salmon and herring fisheries.

Dioxins (polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/F)) are persistent organic pollutants that accumulate in food chains and the fatty tissue of organisms, thus tending to concentrate in fatty Baltic herring and salmon, two key fish species of the Baltic Sea. Dioxins are a health risk to humans

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(Assmuth, 2011; Assmuth & Jalonen, 2005; Tuomisto, Vartiainen, & Tuomisto, 2011), but the way food safety of Baltic herring and salmon is managed also has major socio-economic and cultural consequences.

The dioxin problem is governed at the international, EU-, regional, and national level by policies that aim at reducing dioxin releases (e.g. Directive 2008/56/EC; Directive 2010/75/EU; HELCOM, 2004, 2007, 2010; UNECE, 1979; UNEP, 2009) and controlling the related risk to human health (Commission Regulation (EU) No 1259/2011; Commission Regulation (EU) No 277/2012; Commission Recommendation (EU) 2016/688). The main instrument to manage the risk of dioxins to human health in the EU is the Commission Regulation (No 1259/2011) that restricts the selling of food and feed, based on maximum allowable levels of dioxins.

Dioxins and the related selling restrictions weaken the perceived quality of Baltic salmon and herring as human food and affect the way the catches can be used (Assmuth & Jalonen, 2005; Ignatius & Haapasaari, 2016; Pihlajamäki, Sarkki, & Haapasaari, 2018). This influences fishers' decision-making on where and how to fish, what gear to use and where to sell the catches, having thus major implications for the fishing livelihood, the coastal culture and the availability of the fish for consumers (Ignatius, Haapasaari, & Delaney, 2019). Thus, the dioxin problem affects consumers' dietary habits (Pihlajamäki, Asikainen, Ignatius, Haapasaari, & Tuomisto, 2019), leading also to a lose of the beneficial ingredients (Omega-3, vitamin D) of these fishes (Tuomisto, Asikainen, Meriläinen, & Haapasaari, 2019). In the long term, fishers' decisions affected by the dioxin regulations may influence fisheries managers' decisions on e.g. the allocation of the resources to different user groups. It can be even argued, that the problem stigmatizes the whole Baltic Sea (Ignatius & Haapasaari, 2016; Pihlajamäki et al., 2018).

The research on dioxins in the Baltic Sea and its fish has focused on the biological, chemical and toxicological aspects of the problem (Armitage, McLachlan, Wiberg, & Jonsson, 2009; Assefa et al., 2014; Assmuth, 2011; Vuorinen et al., 2012; Wiberg et al., 2013). The possibilities of reducing dioxins in fish by fisheries management measures have been explored (Kiljunen et al., 2007; Peltonen et al., 2007; TemaNord, 2010), but otherwise little attention has been paid to the fisheries and the related social dimension of the problem. Assmuth and Jalonen (2005) approached the problem from a wide-scale risk governance perspective, referring also to the socio-economic and cultural dimensions.

We discuss the governance challenge of the dioxin problem of the Baltic fisheries, as called for by Assmuth and Jalonen (2005), Assmuth (2011), and Pihlajamäki et al. (2018). The underlying premise of the paper is that by focusing only on dioxin emissions and food safety, the scope of governance remains too narrow as it does not address the socio-economic and cultural impacts of the dioxin problem and its implications on the fisher and coastal communities and the whole fish chain, up to consumers. Therefore, we approach the problem from a more holistic perspective. The aims of the paper are to: (1) analyze the current governance of the dioxin problem and identify related shortcomings, and (2) provide recommendations for improving *governability*, i.e. the capacity of governance to deal with the problem. The analysis is based on a review of literature and policy documents in the framework of interactive governance theory (Kooiman, 2003). The study is part of the BONUS GOHERR project (Integrated governance of Baltic herring and salmon stocks involving stakeholders, 2015–2018) that formed the basis of our understanding of the dioxin problem of the Baltic fisheries and its governance. The project empirically explored the dioxin problem in four Baltic Sea countries: Finland, Sweden, Denmark and Estonia (see: Ignatius & Haapasaari, 2016; Ignatius et al., 2019; Pihlajamäki et al., 2018, 2019; Tuomisto et al., 2019).

In Section 2, we present the theoretical framework and the material and methods used in the analysis. Section 3 is for results and Section 4 provides recommendations. Section 5 is for conclusions.

2. Methodology

2.1. Theoretical framework

Governance refers to the regulatory framework and processes needed for taking societal decisions (Kooiman & Bavinck, 2013). Kooiman (2003) introduced an interactive governance theory for analyzing governance and governability, and the theory has been widely elaborated and applied e.g. in the volumes edited by Kooiman,

Bavinck, Jentoft, and Pullin (2005) and Bavinck, Chuenpagdee, Jentoft, and Kooiman (2013). The theory views governance as a process of interaction between state, market, and civil society actors, the institutional framework enabling the interaction, and the normative values and principles guiding it (Kooiman & Jentoft, 2009). Governability refers to the capacity for governance of a system or problem: to be successful, a governing system must match the entity that it governs, its challenges, boundaries, and scale; follow societal values, norms, and principles; involve relevant actors and organizations, and; allow interaction between them (Kooiman, Bavinck, Chuenpagdee, Mahon, & Pullin, 2008). Ultimately the composition of the governing system determines what issues are addressed and how (Kooiman et al., 2008).

Analysis of governability thus implies assessing how the characteristics of the system-to-be-governed and the governing system match. The theory guides exploring the complexity, diversity, and dynamics of the system-to-be-governed both from the ecological and socio-economic perspectives. The governing system should be analyzed at three levels by addressing: (1) meta-governance, i.e. the normative principles and values that guide governance; (2) the institutional framework of governance (e.g. organizations, rules, policies); and (3) the operational level of governance, consisting of (a) *images,* i.e. the views of the system or problem held by the governing actors, including assumptions about relevant knowledge needs, and goals and solutions for its management; (b) *instruments* that link the images to actions to govern the system or problem; and (c) *actions* that put the instruments into effect.

2.2. Material and methods

We applied interactive governance theory to assess the governability of the dioxin problem of Baltic salmon and herring fisheries. The material used in the analysis consisted of international, EU, regional and national policy documents (e.g. regulations and guidelines) and scientific literature (e.g. research articles and reports) on dioxin emissions and related food safety, and on Baltic herring and salmon fisheries. The material were sought by using Google Scholar and Web of Science, and from the websites of the organizations dealing with the dioxin problem (e.g. United Nations, European Commission, Helsinki Commission, European and national food safety authorities).

The analysis included three main parts. We first summarized the characteristics of the Baltic herring and salmon fisheries and the ecological, food safety related, and socio-economic dimensions of their dioxin problem. Second, we reviewed the current processes and policies to govern the dioxin problem. Third, we assessed governability in terms of how governance matches the problem. This was done by addressing governance principles and values, organizations and actors participating in governance, and operational governance (images, instruments, actions) The first and second part of the results section are thus mainly descriptive aiming to capture the main elements of the system-to-be-governed and the governing system, whereas the third part is based on our interpretation.

3. Results

3.1. System-to-be-governed: the dioxin problem of Baltic herring and salmon fisheries

3.1.1. Dioxin emissions and their bioaccumulation in Baltic herring and salmon

Dioxins originate from long-distance and regional atmospheric sources, such as industry, incineration and other combustion processes, and from local waterway sources caused by the historical use of chlorophenols as wood preservatives and the use of chlorine in pulp and paper industry; the contribution of the sources and the concentration of dioxins in fish varies in different areas (HELCOM, 2004). Dioxins particulate in organic matter, get buried in sediment, and slowly leak back to water.

Dioxins bioaccumulate in Baltic herring and salmon via food web (Peltonen et al., 2007; Vuorinen et al., 2012). Salmon and herring have a predator-prey relationship, and as fatty fish species they absorb fat-soluble dioxins more than fish with lower fat content. Owing to bioaccumulation, dioxin concentration increases with age and size of the fish, and the slower the fish grow the more dioxins they are assumed to absorb (Peltonen

et al., 2007). Thus, population density, competition for food with sprat, and food availability that affect the growth of Baltic herring (Casini, Cardinale, & Arrhenius, 2004) likely affect also the concentration of dioxins in it. In the south-western parts of the sea, the dioxin levels of herring are assumed to be below the maximum allowable levels of dioxins in food and feed defined by the EU. In the northern and eastern parts, herring over 17 cm in length and in the Baltic proper, herring over 21 cm is suspected to exceed the maximum (Commission Recommendation (EU) 2016/688).

Dioxins transfer from herring to salmon during the feeding migration of salmon from the spawning rivers to the Baltic Sea (Vuorinen et al., 2012). The accumulation level depends on the dioxin concentration in the feeding area, prey species, and the fat content and growth rate of the prey. The concentration of dioxins in salmon increases with the individual salmon's size and sea age and spatially shows similar patterns as in herring (Commission Recommendation (EU) 2016/688; ICES, 2018). In general, all Baltic salmon above 2 kg in weight are supposed to exceed the maximum dioxin limits (Commission Recommendation (EU) 2016/688).

3.1.2. Impacts of dioxins on Baltic herring and salmon fisheries

Herring is an abundant and widely distributed species in the Baltic Sea (Casini et al., 2004). It is caught by all Baltic Sea countries being the most abundant commercial catch of the sea (ICES, 2017). It has an important role in the coastal culture and food traditions in the whole Baltic Sea area, and currently Baltic herring is also viewed as an environmentally sustainable food source (Ignatius et al., 2019; Ignatius & Haapasaari, 2016). However, during the recent decades, the human consumption of Baltic herring has significantly decreased (Glynn, Sand, & Becker, 2013; Natural Resources Institute Finland, 2016). Dioxins, the related selling restrictions and the perceived low quality of the fish as food is an obvious reason for the low consumption, in addition to poor availability and consumers' overall food preferences (Ignatius & Haapasaari, 2016; Pihlajamäki et al., 2019). Yet, Pihlajamäki et al. (2018) and Ignatius et al. (2019) found a shared interest among both fisheries stakeholders and experts, and public health experts in the Baltic Sea area, to increase the use of Baltic herring for food, if the dioxin problem can be managed more efficiently.

The majority of Baltic herring catches is sold as feed to fur farms, and to the fish oil and meal industry that produces fodder for aquaculture (ICES, 2017; Lassen, 2011). The dioxin restrictions in food set by the EU also concern feed, but the fish meal and oil factories can remove dioxins from their products. The restrictions do not concern fish fed to fur animals, and thus the fur industry is an important buyer of herring. Fishing herring for industrial purposes is an easy practice for trawlers operating offshore, as the quality of the catch does not need to be of as high a quality as if targeted to human consumption. This allows cost-efficient, longer lasting fishing trips. Actually, fishing for industrial purposes reinforces itself, because it decreases the availability of herring for consumers, fades the perception held by consumers of the fish as human food and further decreases its consumer demand. Thus, the dioxin problem limits the contribution of Baltic herring to regional, EU-level and global food security (i.e. stabile availability, accessibility and utilization of food, FAO, 2008) (Pihlajamäki et al., 2018). For small-scale coastal fishing that targets herring for human food, the dioxin restrictions put an additional burden on top of challenges related to e.g. profitability and a decreasing number of fishers (Ignatius & Haapasaari, 2016).

Baltic salmon has traditionally been one of the most appreciated fish species, 'the king of fishes' and seafood of the Baltic Sea, and especially in the northern Baltic Sea and river areas it has played an important role in the fishing culture and as a source of wealth and wellbeing (Ignatius & Haapasaari, 2018; Ignatius et al., 2019). During the twentieth century most of the salmon stocks were destroyed or depleted, leading to tight restrictions in the commercial fishery from the 1990s, to restore the stocks (ICES, 2018; Romakkaniemi et al., 2003). As a consequence, the commercial fishery has significantly decreased whereas the recreational fishery has increased its share of the total catches (ICES, 2018). Currently only Finland, Sweden, Denmark and Poland have a commercial salmon fishery; elsewhere salmon is bycatch (ICES, 2018). The decline of commercial fishing has implied a significant decrease in the amount of Baltic salmon available for consumers. In parallel, the perceived quality of salmon as food has declined due to the dioxin problem. Today, salmon is mostly a seasonal catch and delicacy in the Finnish and Swedish coastal and river areas of the Bothnian Bay; the Danish and Polish fisheries operating in the southern Baltic Proper have much smaller quotas (ICES, 2018). It is worth noticing, that in

relation to the high cultural value of Baltic salmon, its market price is low (Holma, Lindroos, Romakkaniemi, & Oinonen, 2019). The price of wild captured Baltic salmon is largely determined by imported farmed salmon. Yet, dioxins are seen as a significant reason hampering the development of economically and socially sustainable domestic and export markets for the highly appreciated fish, to contribute to stronger coastal livelihoods while at the same time supporting ecologically sustainable fishing of the vulnerable stocks (Assmuth & Jalonen, 2005; BONUS GOHERR, interviews and workshops).

3.2. Current governing system

3.2.1. Governance of dioxin emissions

The highest level agreements to control dioxin emissions are signed in the framework of the United Nations; the Convention on Long-Range Transboundary Air Pollution (CLRTAP) was adopted in 1979 (UNECE, 1979) and the Stockholm Convention on Persistent Organic Pollutants in 2001 (UNEP, 2009). In the EU, the aim to reduce dioxin releases is incorporated in directives and regulations concerning waste handling (99/31/EC; EEC 259/93), pollution prevention and control (2000/479/EC; 2010/75/EU), protection of groundwater and aquatic environments (2000/60/EC; 2006/118/EC), restrictions on marketing and use of chemicals (91/173/EEC), accident hazards (96/82/EC), and animal nutrition (1999/29/EC; EC No 2439/1999). The EU acts are implemented by the Member States.

In 2001, the EU adopted the Community Strategy for Dioxins, Furans and Polychlorinated Biphenyls as a response to an increased concern of the presence of dioxins in the environment, and several dioxin related accidents and food scandals in different parts of the world (COM 2001/C 322/02; Assmuth & Jalonen, 2005). The strategy was an integrated approach to reduce dioxins and PCBs both in the environment and food/feed through short-, medium- and long-term actions, such as identifying dioxin and PCB sources, assessing contamination levels and human exposure, and developing dioxin expertise and risk assessment and management approaches (COM 2001/C 322/02). The strategy implied defining the maximum levels of dioxins and PCBs in food and feed (Commission Regulation (EU) No 1259/2011; Commission Recommendation (EU) 2016/688).

The European Environment and Health Strategy (COM(2003) 338) called for an integrated framework for improving knowledge of the cycle of dioxins from emissions to humans, to enable identifying the most efficient way to prevent human contamination, and to strengthen the capacity of EU in managing the disease burden caused by environmental factors. The strategy together with the Marine Strategy (COM(2002) 539 final) initiated a pilot project on integrated dioxin and PCB monitoring in the Baltic Sea area for further policy development and actions focusing on specific food items and sources (Tuomisto et al., 2003). The pilot contributed to the adoption of the EU Environment and Health Action Plan (EHAP) for 2004–2010 (COM(2004) 416 final; HEAL, 2010) that aimed to reduce the negative health impacts of certain environmental factors and to enhance cooperation between public authorities in the EU and its Member States, and the civil society.

At the Baltic Sea level, the Helsinki Commission (HELCOM/Working Group on Reduction of Pressures from the Baltic Sea Catchment Area, WG Pressure) coordinates cooperation between the Baltic Sea states, relevant NGOs and other stakeholder groups in environmental issues, the reduction of hazardous substances being one of the focus areas. The main guiding policy for HELCOM is the Marine Strategy Framework Directive (MSFD) (2008/56/EC) that it implements through the Baltic Sea Action Plan (BSAP). One of the MSFD descriptors for good environmental status (GES) is that contaminants in fish and other seafood do not exceed the maximum levels defined by the EC. According to this, one of the aims of BSAP is to make all fish safe to eat (HELCOM, 2007). HELCOM's main instrument for this is recommendations of measures for the Baltic Sea countries to minimize dioxin emissions from both small-scale combustion and large-scale industrial sources (HELCOM, 2004, 2010).

3.2.2. Governance of food safety

The General Food Law (EC 178/2002) lays down the principles, requirements and procedures for governing food safety of Baltic salmon and herring. The key instrument in managing the dioxin problem of Baltic fish

is the maximum level of dioxins in food and feed (Commission Regulation (EU) No 1259/2011). The maximum level in relation to fish size and fishing area (Commission Recommendation (EU) 2016/688) functions as a reference point for the EU to restrict the selling of Baltic salmon and herring within its area. The maximum level is defined by the Directorate General for Health and Food Safety of the EC (DGSANTÉ) based on risk assessments conducted by the European Food Safety Agency (EFSA) (EFSA, 2004, 2010; Commission Regulation (EU) No 277/2012). The risk assessments integrate knowledge about the human exposure to dioxins in different foodstuffs across European populations, and the assessed potential of dioxins to cause adverse health effects. The Advisory Group on the Food Chain and Animal and Plant Health provides the EC with stakeholders' views on food safety policy. Also EFSA has recently improved the opportunity of stakeholders to contribute to the different stages of scientific assessment and communications (EFSA, 2016).

Within the risk levels, the Member States fishing Baltic salmon and herring are allowed to develop their own strategies to deal with the problem. This has led to a variety of practices in different Baltic Sea countries, as will be described in section 3.2.3.

Finland and Sweden have been granted an exemption to sell Baltic salmon and herring within their domestic market without restrictions. The exemption obliges monitoring the levels of dioxins in fish and based on that, informing consumers about the risks of fish intake (Commission Regulation (EU) No 1259/2011; Commission Recommendation (EU) 2016/688). In these countries, the dietary recommendations are based on assessments of both risks and benefits of Baltic fish to different consumer groups, and targeted to the groups accordingly (Glynn et al., 2013; Tuomisto et al., 2015). The scope and content of the dietary recommendations vary. In Sweden, risk groups are advised not to eat fatty Baltic fish more often than two or three times a year and other people once a week at the most (Swedish National Food Agency, 2019). In Finland, the recommendation allows the risk groups to eat Baltic salmon and large Baltic herring (over 17 cm) up to once or twice a month, whereas restrictions for other consumers do not exist (Finnish Food Authority, 2019).

3.2.3. Dealing with food safety in fisheries governance

Baltic salmon and herring fisheries are governed in the framework of the Common Fisheries Policy (CFP) (Regulation (EU) No 1380/2013). Also the multiannual plan for the stocks of cod, herring and sprat in the Baltic Sea guides the management of Baltic herring (EU, 2016/1139). At the EU level, the main governing actor is the Directorate General for Maritime Affairs and Fisheries (DGMARE) that prepares the issues for the Ministerial Council that takes the decisions on the total allowable amounts of fish to be caught each year. The main scientific advisors are the International Council for the Exploration of the Sea (ICES), and the EC's own scientific body, the Scientific, Technical and Economic Committee for Fisheries (STECF). Regional-level expertise is provided by the Baltic Sea Advisory Council (BSAC) that brings together stakeholder organizations and the Baltic Sea Fisheries Forum (BALTFISH) that promotes coordination between the Member States (Eliasen, Hegland, & Raakjaer, 2015; Linke, Dreyer, & Sellke, 2011). The decisions taken by the EU Ministerial Council are implemented by the Baltic Sea states.

Fisheries governance focuses on managing the stocks, and does not deal with food safety issues such as dioxins. Thus, requirements relating to food safety are mainly dealt with at the national level. Based on their exemptions, Finland and Sweden can place salmon and herring on their national markets without restrictions given that consumers are informed about the risks (Commission Regulation (EU) No 1259/2011). In Estonia, a strategy to target small herring that does not contain dioxins beyond the risk level and to sort the catch to comply with the regulation has been developed. In Denmark, most of the Baltic herring catch is used for industrial purposes, although the Danish herring fishers can sell herring caught from the south-western parts of the Baltic Sea for human consumption owing to the lower dioxin levels (European Commission, 2012). As for salmon, the Danish fishermen can place the fish on the food market based on the EU guideline that allows selling salmon below 7,9 kg for human consumption, given that the parts containing most dioxins (deep skin, ventral parts) are removed and the dioxin levels of the salmon catch are analyzed before marketing (Commission Recommendation (EU) 2016/688).

3.3. Governability of the dioxin problem of Baltic herring and salmon fisheries

3.3.1. Limited scope of principles and values

The Code of Conduct for Responsible Fisheries (FAO, 1995) identifies sustainability and food security and safety among the main universal principles of fisheries governance, and the Agenda 2030 for sustainable development (UN General Assembly, 2015) stresses that these principles should guide all policy domains, including food, health and environmental governance. However, in the EU, the underlying principle in the governance of the dioxin problem of Baltic fish is to protect humans and the environment from the pollutants (UNECE, 1979; COM 2001/C 322/02) whereas sustainability and food security are not acknowledged. The limited scope of principles in governance, together with the use of strong precautionary principle to minimize human exposure to dioxins, has led to the restrictions on the sale of Baltic herring and salmon. The restrictions support the use of Baltic herring for industrial purposes and undermine the local and regional values that have traditionally made Baltic herring and salmon an important part of livelihoods, diets, and wellbeing in the Baltic Sea area (Ignatius et al., 2019).

Similarly, fisheries governance has focused on managing harvest according to the principles of sustainability, paying little or no attention to food security and safety. Although the CFP (Regulation (EU) No 1380/2013) refers to the importance of food and feed security and safety, these principles are not included in the species-specific governance of fisheries. Consequently, in the absence of clearly defined objectives for food security and safety, also related problems such as dioxins remain unresolved (Pihlajamäki et al., 2018).

The analysis suggests that in both dioxin governance and fisheries governance, the normative basis guiding the procedures is narrow and only partially in line with the universal principles of sustainable development and responsible fisheries.

3.3.2. Mismatch in governance scale, lack of sectoral collaboration

The governance of the dioxin problem of Baltic salmon and herring is strictly EU-driven and realized at the EU and national levels. The main EU organizations dealing with the problem are the DG Environment, and the DGSANTÉ, whereas the DGMARE is not, at least in a formal way, involved in the decision making processes dealing with dioxins. Similarly, the EU fisheries policy making processes do not deal with the dioxin problem. At the regional level, the HELCOM addresses the dioxin problem, but the focus is on emission control. Other regional actors, namely BSAC and BALTFISH, are involved in basic fisheries management, which does not include food security and safety issues. The state level focuses on the country specific procedures to deal with the EU food safety regulation. This suggests that although the core of the dioxin problem is at the regional level, any regional-level coordination to manage the fisheries-related dioxin problem does not exist.

Regarding consultation of stakeholders in the EU food safety governance, the only representative of the fisheries sector is the European Fish Processors & Traders Association whereas fishers' organizations are not members of the advisory group (Commission Decision 2017/C 230/05). Moreover, the fisheries sector is not represented in the stakeholder organs of EFSA (EFSA, 2018b). It therefore seems that fisheries stakeholders (fishers and their associations, producer organizations, fisheries managers, environmental NGOs, etc.) in general, and Baltic fisheries stakeholders in particular have minimal possibilities to influence in the policy making regarding the dioxin issue, e.g. prior to forming management proposals.

3.3.3. Narrow image leads to partial solutions

At the EU-level governance, the dioxin problem of Baltic Sea fish is viewed primarily as a food safety problem that must be managed through reducing the presence of dioxins in the environment and in food and feed. Consequently, natural scientific expertise, methods, and data are seen as the main resources needed for solving the problem. The General Food Law (Regulation (EC) No 178/2002) acknowledges the need for societal, economic, traditional, ethical and environmental information for food-related risk management; yet such information is not incorporated in the governance of the dioxin problem.

The main governing instrument to reduce dioxins in the environment is regulations on emission reductions. The instrument contains an implicit promise that the problem will disappear in the course of

time as dioxin concentrations decrease. However, emission reduction is a slow process, e.g. due to uncertainty about emission sources (Armitage et al., 2009). This suggests that in the short-term other instruments are needed to govern the problem. Yet, the focus on emission control may discourage the development of such instruments.

The food safety of Baltic fish is governed by the regulation on the maximum level of dioxins in food. However, the regulations are based on risk assessments that involve high uncertainties (data, models, decision rules) and ambiguity in defining the risk limit and its conversion to an acceptable level of dioxins in food and feed and further in Baltic fish (Assmuth, 2011; Assmuth & Jalonen, 2005). The beneficial health effects of the fish relating to Omega-3 fatty acids and vitamin D are not taken into account, which makes the issue even more ambiguous (Assmuth, 2011; Assmuth & Jalonen, 2005). Thus, the effects of Baltic herring and salmon intake on human health and the right way to deal with the dioxin issue is a much debated topic, as indicated e.g. by the differing eating recommendations of Finland and Sweden that reflect differences between the countries in their risk assessment approaches, in balancing risks and benefits, and in their views of the tolerability and acceptability of the dioxin risk (Assmuth & Jalonen, 2005; Tuomisto et al., 2003). This leaves room for considering possibilities for other types of approaches to govern the problem.

The rules about selling fish containing dioxins set by the EU are put into action at the national level by the fisheries sector. The EU does not dictate how the regulation should be implemented, apart from continuous monitoring of dioxins in fish. Consequently, national strategies to deal with the dioxin regulation have emerged. Strategies such as targeting small safe-to-eat Baltic herring for human consumption integrate the socio-economic and cultural values associated with the fish, and the food security principle, into fisheries governance. However, in the absence of region-wide collaboration on implementing the food safety regulation, for example the contribution of Baltic herring to food security remains underutilized (Pihlajamäki et al., 2018). Moreover, it seems that lack of guidance on how to deal with the dioxin problem while also considering the other governance principles, has left room for actions that are not compliant with the regulation (see e.g. European Commission, 2013; European Commission, 2014). It may be concluded, that a wider image and scope of instruments on the governance of the dioxin problem of Baltic herring and salmon could lead to more comprehensive management solutions where the different principles and values are accounted for.

4. Recommendations

This paper suggests that the current governance of the dioxin problem of Baltic herring and salmon fisheries poorly matches the problem, because it ignores the socio-economic and cultural dimension of the problem as well as the dimension relating to food security. According to the analysis, the governance of the problem could be improved through four main actions.

First, adopting environmental, economic and social sustainability and food security and safety as shared principles between the environmental, food safety/public health, and fisheries policies, would be in line with the universal UN principles, support coherence between the sectors, and encourage joint considerations on how fish resources are and should be used, and acting accordingly. However, adopting shared principles for different sectors could be difficult due to institutional inertia; it would imply a need for balancing between principles and giving up on those established practices that do not support them.

Second, establishing collaboration between the environmental, public health and fisheries sectors in governing the dioxin problem at the regional level e.g. by adopting a new operational multi-sector strategy would support the development of holistic strategies to deal with the problem at the most relevant governance level. We see BSAC, BALTFISH, and HELCOM as key organizations in developing a regional level platform for dealing with the dioxin problem. A regional approach for dealing with the problem would conform to the strive for regionalization in the fisheries and environmental sectors in order to implement an ecosystem-based management approach that involves the aim to bring decision making closer to those affected and using their experience and knowledge in governing complex problems (Raakjaer, van Leeuwen, van Tatenhove, & Hadjimichael, 2014; Symes, 2012). A regional approach to governing the dioxin problem would, however, require joint understanding among the organizations about the need for regional governance and joint belief about the possibilities

of regional actors to develop new instruments to support or replace the selling restrictions in governing the dioxin problem.

Third, enhancing interaction around the dioxin problem within the fisheries sector, i.e. between the salmon and herring fishery stakeholders (BSAC), scientists (ICES, STECF) and policy makers (BALTFISH, DGMARE) would enable sharing knowledge and views about the dioxin issue and its socio-economic and cultural effects both at the pan-Baltic and basin level, support developing regional adaptive strategies to deal with the problem, and empower the stakeholders to contribute to the EU-level governance (Constanza, 1998; Gray, 2005). A shared interest to solve the dioxin problem could even nurture collaborative attitude in other fisheries related issues that have traditionally been more conflict-prone.

Fourth, supporting the participation of the Baltic fisheries stakeholders in the EU-level food safety governance concerning dioxins would improve the procedural fairness of policy-making by providing those subjected to the decisions at least a chance to voice their views and concerns (Dreyer & Renn, 2009, 2014). In addition, it would acknowledge the fisheries sector as an important food producer group that must be represented in food safety governance. The main challenge for the participation of Baltic fisheries stakeholders in the permanent stakeholder organs of DGSANTE and EFSA are current membership standards, which require EU-level representation. On the other hand, EFSA has recently introduced several targeted platforms that could provide entry points for initiating dialogue on specific issues; this would, however, require proactivity from the fisheries sector.

Acknowledging a wider variety of principles and involving a wider variety of actors in governing the dioxin problem would widen the image held by the governing actors of the problem from a purely natural scientific problem towards a more multidimensional one, and the toolbox of governing instruments to better address the different dimensions. This would futher enable developing the current hierarchical governance relying on top-down regulations towards collaborative approaches, thereby improving both the knowledge base of governance, and the legitimacy and effectiveness of decisions (Gray, 2005; Klintman & Kronsell, 2010; van Ginkel, 2005).

We acknowledge that the ambiguity of the dioxin problem might hinder the development of its governance. For some people, the problem does not exist, or they think that it will be solved by itself along with reducing dioxin emissions in the future. Others think that the problem can be managed only in scientific terms whereas the stakeholders do not have anything to contribute. The current highly natural scientific image of the dioxin problem relies on emission reduction and minimizing the health risks as the main governance instruments, both of which are based on highly uncertain and ambiguous scientific knowledge. It can be asked, if developing ever more sophisticated science around the problem without opening other perspectives to it can lead to a situation where the tolerable intake levels become moving targets when revisited based on new methods and data (e.g. EFSA, 2018a). We see uncertainty and ambiguity as major reasons for reconsidering whether the current governance really matches the dioxin problem.

This analysis suggests that governing a complex social-ecological problem requires not only interaction between state, market, and civil society actors within one sector but also between sectors. The need for collaboration between sectors to exchange information on shared issues and to identify joint objectives has been increasingly acknowledged in different policy areas including environmental and fisheries issues (Berkes, 2012; Long, Charles, & Stephenson, 2015; Raakjaer et al., 2014), and public health (Salunke & Lal, 2017). As described in this paper, integration between the environmental and public health sectors in governing the dioxin problem has emerged from the beginning of the 2000s. Aligning fisheries governance with these sectors would support creating holistic and synergistic solutions for the dioxin problem (Love, Pinto da Silva, Olson, Fry, & Clay, 2017). Such solutions would imply a step towards a food system approach as called for by the 2030 Agenda for the sustainable development (UN General Assembly, 2015). Implementation of the approach requires a parallel focus on the different parts of the system, its actors, and relevant policies to identify actions and to deliver outcomes that benefit producers, consumers, and the environment at the same time (EEA, 2017).

The importance of sustainability and food security is growing in the face of climate change, and a climate-smart food system is called for (Wheeler & von Braun, 2013). Fuel-efficiently caught fish has been argued to

be an important part of climate-smart food systems, given that the fish populations are sustainable (Carlsson-Kanyama & González, 2009). The current governance of the dioxin problem relying on maximum dioxin levels restricts the use of Baltic Sea fish for food security and the utilization of the beneficial ingredients of the fish for human health. Furthermore, it affects dietary customs based on local natural food and ways of life. This entails a requirement to improve the governance of the dioxin problem of Baltic fish to match the problem as a whole.

5. Conclusion

In this paper, we discussed the governance challenges of the dioxin problem of Baltic herring and salmon fisheries. We argued that these challenges are rooted in the limited scope of the dioxin governance focusing on the environmental and health issues and neglecting the socio-economic, cultural, and food security related dimensions of the problem. The analysis indicates that the capacity of governance to deal with the problem could be enhanced by reframing the dioxin problem in a more holistic way and rebuilding governance based on interaction between the environmental, the public health and the fisheries sector.

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